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THE SEARCH IN FOREIGN COUNTRIES FOR BLIGHT-RESISTANT CHESTNUTS AND RELATED TREE CROPS

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INTRODUCTION

The introduction of chestnuts and related species from foreign countries has been made a feature of the agricultural explorations of the United States Department of Agriculture for more than 25 years. The early attempts to introduce these useful crop plants were made primarily for the purpose of procuring improved types for breeding and orchard culture. Material in the shape of nuts and occasional root cuttings and grafting wood was received from Spain, Italy, China, Japan, and other countries as early as 1899 and also in 1901 and 1902. In 1901 some rather extensive agricultural exploration work was undertaken by G. D. Brill. The Office of Foreign Plant Introduction of the Bureau of Plant Industry had been organized but a short time, and Doctor Brill was one of the early agricultural explorers. He made some rather extensive collections in the vicinity of Hankow and Ichang, China, where certain types of chestnuts resembling our American species were found. This may have been the first introduction into the United States of what afterwards became known as the Chinese hairy chestnut (*Castanea mollissima* Blume).

Three years after Doctor Brill's work in China, that is, in 1904, the chestnut-blight disease was discovered in New York State. A

year later, when one of the first publications on this disease appeared, it was evident that a serious problem was at hand, a problem involving the future welfare of our great American chestnut forests. The onsweep of the devastating bark disease is a matter of history. It spread rapidly through all the chestnut regions of the eastern United States and, according to specialists in the department, has now reached the southern limit of commercial chestnut growth in northern Georgia and northwestern South Carolina. It appears from all the evidence at hand that it is only a question of a few years when our former great chestnut forests will be extinct and we shall have to look elsewhere for materials to meet the needs this valuable tree has in the past provided. While the blight was devastating the chestnut forests, orchards of chestnuts in the New England and Middle Atlantic States were also wiped out, so that there is no longer any orchard culture of consequence east of the Allegheny Mountains.

When it first became evident that the chestnut blight was a menace of the first magnitude, renewed interest was aroused in foreign explorations for the purpose of discovering new forms that might be of use in meeting the situation. From 1903 to 1912 numerous lots of Chinese and other chestnuts were received, grown, and distributed in the course of the foreign plant introduction work. Meanwhile the origin of the chestnut-blight fungus remained unknown, and it was not until the spring of 1913 that it was discovered in China under conditions that left no doubt that its original home had been found. The discovery was made by the late Frank N. Meyer, agricultural explorer of the Bureau of Plant Industry, United States Department of Agriculture. He found the disease attacking the Chinese hairy chestnut (*Castanea mollissima*), and also evidence that this chestnut was resistant in varying degrees. From 1913 until the present time the search in foreign fields for blight-resistant chestnuts and related species has continued.

In 1921 J. F. Rock began systematic work in agricultural explorations for the Bureau of Plant Industry, United States Department of Agriculture, that year confining his activities mainly to Siam and Burma. In August, 1922, Mr. Rock undertook an extensive and detailed search for new chestnuts and related species in the Province of Yunnan, western China. This Province lies north of Siam and on the northeastern border of India. The country is difficult of access. It is a region of magnificent mountains, high plains, large and small valleys, deep gorges, and rushing waters. The climate is unlike anything in this country, subtropical in the lowlands, with clouds, fogs, and snows on the high elevations, with which the country abounds. At the higher elevations, 5,000 to 12,000 feet, the winter temperatures are not low, but the snows are heavy.

Mr. Rock spent several weeks in the primeval forests of this interesting region, collecting large quantities of seeds, which were carefully packed and started on their long and hazardous journey late in the fall. After many vicissitudes the seeds reached Washington, closing a chapter of one of the most extensive undertakings of the kind on record. Mr. Rock remained in the region through the winter, spring, and summer of 1923, and was enabled

in September, 1923, to make another collection of nuts thought to be those of a chestnut. This was one of the most successful shipments of this explorer, and resulted in obtaining nearly 6,000 little trees from the seeds sent in.

On several occasions the Office of Foreign Plant Introduction has secured the services of J. H. Reisner, of Nanking University, Nanking, China, for the purpose of collecting various seeds and plants. Professor Reisner, through his association with the College of Agriculture and Forestry, has been in a position to make a careful study of the chestnuts in that part of China. A number of large shipments of nuts have been received from him; and these, having been packed properly, reached the department in excellent condition. Practically all these seeds were those of the Chinese hairy chestnut (*Castanea mollissima*).

In July, 1924, P. H. Dorsett, long connected with the work of the Office of Foreign Plant Introduction, left for northeastern China, accompanied by his son, James H. Dorsett. The explorations made by Dorsett and Dorsett have resulted in procuring additional chestnut material, including nuts from wild and cultivated trees from the regions north and northeast of Peking.

In view of the great interest in substitutes for our native chestnut that may prove able to withstand the blight and be utilized in breeding work, looking to the supplying of timber, tannin, and food, it has seemed desirable to bring together certain data bearing on the species already introduced or that may be introduced. This seems particularly necessary, inasmuch as there is considerable confusion and some misunderstanding as to the real merits of the introductions heretofore made.

BOTANICAL CONSIDERATIONS

The substitute trees referred to belong to a group of five genera scattered rather widely over the world: (1) Beech trees, belonging to the genus Fagus; (2) chestnuts (Castanea); (3) oaks (Quercus); (4) Lithocarpus, and (5) Castanopsis. In this circular only the Castaneas, or chestnuts, and the species of Castanopsis will be considered. The latter we may call evergreen chinquapins, because their leaves are not shed in the fall.

The genus Castanea, containing the chestnuts, is confined to the Northern Hemisphere and embraces nine known species, of which four occur in the United States, one in southern Europe, one in Japan, and three in China. A few of the species are shrubby. Others, like our own American chestnut, the Chinese hairy chestnut, and the Chinese timber chinquapin, grow into tall trees. The leaves of the chestnuts are deciduous; that is, they fall at the approach of cold weather. The bark is usually deeply furrowed, and the wood is porous. The nuts are borne in spiny burs, which on maturing split into two to four valves (fig. 1).

The genus Castanopsis is closely related to Castanea and includes 25 or more species, one of which, namely, *Castanopsis chrysophylla*, "erroneously called the golden-leaf chestnut," occurs along the western slopes of the Cascade Mountains in Oregon and in the coast ranges of California. Nearly all the species of Castanopsis are

found in southeastern Asia. Twenty-two species are described by King as being Indo-Malayan forms.[1]

The species of Castanopsis are trees, many growing to large size; the foliage is evergreen. The nuts are usually small and somewhat

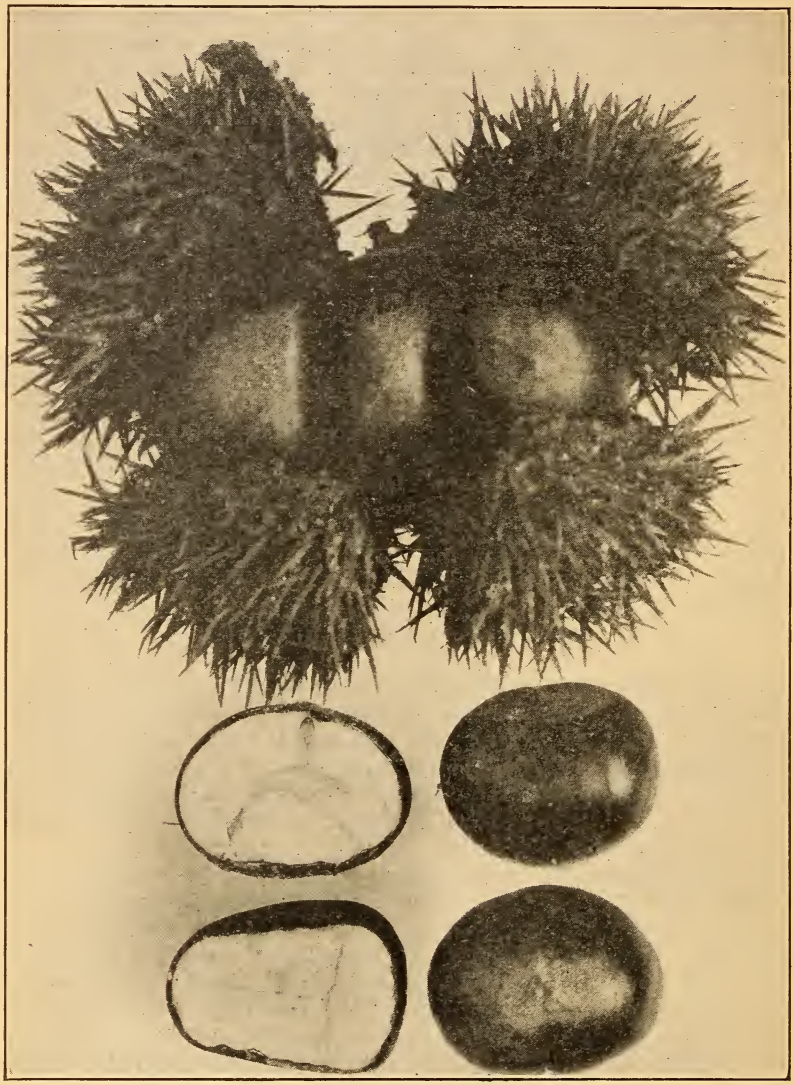

FIG. 1.—Bur and nuts of the Chinese hairy chestnut (*Castanea mollissima* Blume). Collected by Dorsett and Dorsett in Chihli Province, China, October 11, 1924. Slightly reduced. (P29560FS)

resemble acorns; they mature the second year and are borne in burs covered by stout spines.

[1] KING, G. THE INDO-MALAYAN SPECIES OF QUERCUS AND CASTANOPSIS. Ann. Roy. Bot. Gard. Calcutta, vol, 2, pp. 17–107, pls. 15–104. 1889.

The promising members of the two genera will be briefly described, summarizing as concisely as possible the results obtained and the possible economic uses of the various forms already introduced or worthy of introduction.

CHESTNUTS

(*Castanea* spp.)

The botanical characters of Castanea have already been noted. This genus is by far the most important economically, as most, if not all, of the species probably will grow in any region where our native form thrives.

CHINESE HAIRY CHESTNUT

(*Castanea mollissima* Blume)

Reference has been made to some early introductions of chestnuts from China by Brill and the probability that these were *Castanea mollissima*. These introductions, made in 1901, were inventoried and recorded in the usual way and later distributed. All traces of these trees have disappeared. According to E. H. Wilson,[2] *Castanea mollissima* was introduced at the Arnold Arboretum, near Boston, Mass., by C. S. Sargent, who procured seeds in 1903 in the market at Peking, China.

The records of the Office of Foreign Plant Introduction show that more than 25 importations of this chestnut have been made. It was not until 1913, however, that it was recognized by the office as a distinct species and called by its right name. Prior to 1913 it was listed and distributed under the name *Castanea sativa*, which is the common chestnut of Spain, Portugal, Italy, and other countries in southern Europe and northern Africa.

Castanea mollissima is distributed over most of northern and central China. It is found in the eastern and also in the far western Provinces, including Yunnan, where it was collected by Rock. In a wild state the chestnut constitutes a considerable part of the forests of certain regions. The districts where it seems to be cultivated most extensively are found to the north and northeast of Peking. Considerable areas are given over to the cultivation of this tree in Chihli Province, and from the records at hand it has for many years been an important source of food there. According to Meyer and others who have visited the chestnut regions in China, it is the practice to plant the trees in large or small areas here and there along the bases of hills and on the sloping foothills (fig. 2). In the native forests the trees grow to a height of 40 to 60 feet, with trunks 3 to 6 feet in girth. The nuts closely resemble our native species in size, color, sweetness, and flavor (fig. 1). There is much variation in the species as to size and quality of nuts and size and vigor of trees. Evidently there are numerous horticultural types. From Meyer's studies it would appear that there is variation in its ability to resist blight in the native orchards and forests.

According to Meyer's notes, it is the practice of the Chinese growers to give special attention to the trees with respect to treatment for blight. The diseased areas are cut out and scraped with a great

[2] SARGENT, C. S. PLANTAE WILSONIANAE. Vol. 3, p. 194. 1916.

deal of care. Evidences of treatments of this kind were found by Meyer on trees believed to be at least 300 years old. There is no evidence from Chinese sources as to the continuous fruitfulness of the trees; that is, whether they are annual bearers or bear fruits only in certain years.

At the beginning of 1914, and at intervals since that time, extensive importations of the nuts of this tree have been made by the Bureau of Plant Industry, and seedlings have been grown from them at several of the plant-introduction gardens. In some instances the seeds have been stratified in the usual way in beds in the open ground, the nuts being allowed to freeze where practicable, and early in the spring they have been lifted and planted in drills or nursery rows. This has been the practice where the seeds were received fresh and were not badly infested with weevils.

Fig. 2.—A grove of old trees of the Chinese hairy chestnut near Santunying Chihli Province, China. Note how the trunks and limbs have had the bark scraped off. This is partly to protect the trees against insects and diseases. (P5846FS)

Another method, and one which is more dependable, consists in sowing the seeds as soon as practicable after being taken from the tree, using flats or a bench in a greenhouse where a little bottom heat can be given. The temperature of the house is kept low; in fact, it is best that night temperatures do not exceed 40° F. As rapidly as the seedlings germinate and make a few leaves, five or six are planted in a 6-inch pot, setting them around the rim. The seedlings are carried through the winter in this fashion, and as soon as the weather is suitable in spring, usually about May 10 to 15, the balls of soil containing the little trees are lined out in a nursery. The seedlings are not broken apart in this operation, and the balls are set as close as they will stand. The following fall the seedlings may be lifted, separated, stored, and the next spring lined out in nursery rows for the second year's growth. Usually seedlings grown

by this method are more easily transplanted, as the roots are inclined to be fibrous, making it less difficult to handle the trees. Despite all precautions, the seedlings do not take very kindly to these practices. They must be handled with care and are not so easily transplanted as are fruit trees, such as pears, apples, and cherries.

During the past 10 years something over 10,000 nursery-grown seedlings of *Castanea mollissima* have been distributed to all parts of the United States. No serious efforts have been made to set out these trees in orchard blocks. A good many have gone to public parks, others have been placed in the hands of foresters, and considerable numbers have found their way into test nurseries and the gardens of private experimenters. Efforts to determine what has happened to these trees show that fully nine-tenths of them have been lost. Drought, frost, fire, and lack of adaptability to climate are set down by those who received the trees as the principal causes of their death. A good many cooperators of the department report that blight caused the death of many trees, although numbers report that these trees have resisted blight, whereas the American chestnut in the same neighborhood succumbed.

In 1912 the late Walter Van Fleet, of the Bureau of Plant Industry, established a test orchard of chestnuts at Bell, Md., 15 miles northeast of Washington, D. C. This orchard was planted with *Castanea mollissima* seedlings, also a number of hybrids produced by Doctor Van Fleet, and a collection of selected types, the selections being largely from the Japanese chestnut (*Castanea crenata*). About 900 of the *Castanea mollissima* trees were planted, the seedlings being grown from seeds sent from Tientsin, China, in 1911.

The country around Bell was at one time the home of forests of our native chestnuts. A good many old trees were still standing in the neighborhood at the time of planting the orchard. Nearly all of these old trees have been killed by blight. The Chinese hairy chestnuts (*Castanea mollissima*) and a good many of Doctor Van Fleet's hybrids and selections are still living and growing well (fig. 3). Marked differences have developed in the seedlings of *Castanea mollissima*. Some produce larger nuts than others; some are more vigorous than others. One or two trees are steady bearers, while some are shy bearers.

There is little information at present that would encourage the belief that the Chinese hairy chestnut may be utilized as a substitute for our native species in the production of timber or for tanning purposes. To provide future timber and tannin supplies for this country is a complex economic problem that must be viewed from many angles and can not be discussed here. As a possible source of a valuable food crop and perhaps poles, posts, and similar timber, *Castanea mollissima* seems well worthy of study and extension. The tree lends itself readily to orchard or intensive culture and begins to bear when 6 or 7 years old. The trees for orchard culture may be planted as close as 14 by 14 feet, but 18 by 18 feet is better. Such trees should be pruned sparingly. Experience has shown that the head should be formed early, followed by limited pruning later. The trees do best when left to grow naturally. See Figure 3, showing natural growth on the left and pruned growth on

the right. The trees should have good culture, like the apple, peach, and pear. They can not be left to care for themselves with much hope of success.

The United States Department of Agriculture, through the Bureau of Plant Industry, is endeavoring to establish this promising tree in the region formerly occupied by our native species. Up to this time dependence has been placed on Chinese sources for our seed supply, and this is becoming more and more precarious. As a first step, it would seem important to establish a considerable number of small orchards, mainly for the production of home-grown seeds. In the spring of 1926 and in 1927 the Office of Foreign Plant Introduction will be in a position to supply limited numbers of young *Castanea mollissima* trees for experimental orchard planting

FIG. 3.—A young orchard of Chinese hairy chestnuts at Bell, Md. Trees on the right pruned; on the left unpruned. Pruning wounds should be treated to prevent infection. (P24253FS)

in regions east of the Allegheny Mountains where blight occurs. Trees can not be sent outside of the regions indicated on account of the danger of spreading blight. It is planned to limit the plantings to about 1 acre in each locality. Planting trees 18 by 18 feet will require 134 to the acre. They will need to be cultivated and the ground planted to some suitable green-manure crop for the first four or five years. After that it will likely be best to put the orchard in grass except directly under the trees. Details of this plan of cooperative planting will be furnished on request.

To those interested in breeding and selection work the Chinese hairy chestnut offers promising material. Crosses between *Castanea mollissima* and our native chinquapin (*C. pumila*) might well be worth while. Such crosses have already been made (fig. 4). One in particular should be mentioned. It was made by the late Doctor

Van Fleet, and the original tree is growing at the Bell (Md.) garden. This tree is more than 10 years old and for the past five

FIG. 4.—Hybrid chestnut (about two-thirds natural size). A cross between the Chinese hairy chestnut and one of our native chinquapins. The tree yields fine nuts, bears abundantly every year, and has shown marked blight resistance. (P35503FS)

years has borne heavily each year. The nuts are about double the size of our native chestnuts and are sweet and palatable. The tree

has shown no signs of blight. This tree and others are being made the subject of breeding and pathological studies by G. F. Gravatt, in charge of the chestnut-blight investigations of the Office of Forest Pathology.

To extend the range of the chestnut southward, further crosses might be made between *Castanea mollissima* and *C. alnifolia*, the

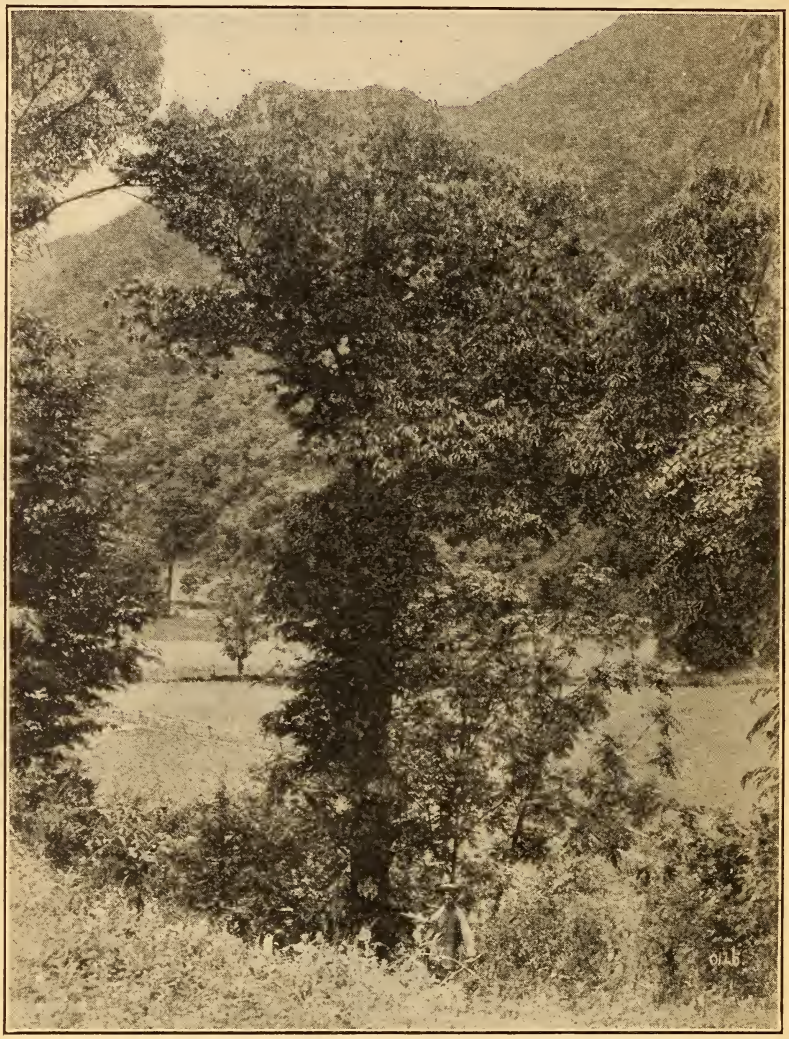

FIG. 5.—Chinese timber chinquapin (*Castanea henryi* (Skan) Rehder and Wilson). A large timber tree from western China well worthy of introduction. (Photographed by E. H. Wilson, of the Arnold Arboretum)

latter being a shrubby chinquapin found along the Atlantic coast from North Carolina to southern Georgia. Both of these chinquapins are very resistant to blight. When material is available, crosses might be made between *C. mollissima* and *C. henryi*, the timber chinquapin of China (fig. 5).

Crosses between the Chinese hairy chestnut and the Japanese chestnut (*Castanea crenata*) might yield valuable hybrids, the latter being very resistant and yielding nuts of good size.

Data as to the location of bearing trees providing suitable material for breeding will be furnished on request.

EUROPEAN CHESTNUT

(*Castanea sativa* Miller)

The European chestnut has been cultivated and used for centuries in many parts of the world. It is one of the most widely distributed nut-food trees. It may have come from eastern Asia. Certain it is that it was well scattered throughout the south of France at the beginning of the Christian era. It was early introduced into Britain, probably by the Romans, and became so well established that it behaves like a native tree. The nuts were easily transported and early introduced into the United States. There are records of grafted trees and small grafted orchards in this country before the Revolutionary War. The early Spanish colonists scattered the trees throughout their possessions, and the species thus became established in many Spanish countries. It was taken to the Philippines by the Spaniards, and according to P. J. Wester ancient trees are still occasionally met with in old monastic gardens on those islands.

The European chestnut grows to a large size, often attaining a height of 90 feet or more with a girth of 20 to 30 feet. The leaves are oblong-lanceolate, with rather coarse serrations. The nuts are larger than those of the Chinese hairy chestnut and our own American species. The shell is dark brown and is usually tough and leathery. The quality of the nut is rather indifferent and does not compare favorably with our own chestnuts and a number of other species that will be mentioned later.

The Office of Foreign Plant Introduction has made several importations of this chestnut, but nothing new has developed as a result of this work. Considerable areas were planted to this chestnut in Pennsylvania, Delaware, and on the Eastern Shore of Maryland prior to the advent of the blight, by which most of these orchards have been swept out of existence. As blight has not invaded the Pacific coast, trees of the European chestnut are now found in the valleys of Washington, Oregon, and California. There are also scattered plantings in sections west of the Allegheny Mountains, but most of these are hybrids and not pure types of *Castanea sativa*.

Because of the rather indifferent quality of the nut and its susceptibility to blight, there would appear to be no great future for this chestnut in this country except as a possible source of supplying timber and tannin when planted outside of our native chestnut region. There are numerous varieties, some of which are believed to be hybrids. It is possible that some of these hybrids, containing as they probably do the blood of our own native chestnut, might prove of value for further breeding work, using *Castanea mollissima* and possibly *C. crenata* and our own native chinquapin for crossing. There may be and doubtless are European varieties and types of this chestnut worthy of introduction for breeding and

other purposes. The countries of eastern Asia and western and southwestern Europe might yield types worthy of further trial in this connection.

CHINESE TIMBER CHINQUAPIN

(*Castanea henryi* (Skan) Rehder and Wilson)

Little is known of this chinquapin except what has been published in comparatively recent times in some scattered botanical periodicals. It is known by various names—*Castanopsis henryi*, *Castanea sativa*, *C. vilmoriniana*, and *C. fargesii*. *Castanea henryi* has been known to botanists for 18 or 20 years. It is not found in general cultivation and has been introduced but sparingly into arboreta and botanical gardens. (Fig. 5.) According to E. H. Wilson, Assistant Director of the Arnold Arboretum, *C. henryi* is growing there and without sign of disease. A specimen planted by the late Doctor Van Fleet is growing at the United States Plant Introduction Garden at Bell, Md. This specimen was propagated from scion wood received through the courtesy of Prof. C. S. Sargent, of the Arnold Arboretum. This fine chinquapin was found by Wilson at a number of places in central China, and Sargent says [3] that the species is distributed from the neighborhood of Ningpo through the valley of the Yangtze River as far west as Mount Omei. On the mountains of western Hupeh and of eastern Szechwan it is common in woods.

According to Sargent this chinquapin grows to a larger size than any other Chinese species, and trees from 20 to 25 meters tall with trunks 1 to 3 meters are common. Occasionally trees 30 meters tall and 5 meters in girth of trunk are met with. The leaves are green on both surfaces and entirely glabrous except for a few appressed hairs on the under side of the primary and secondary veins. All the fruits we have seen contain a solitary nut, but it is probable that occasionally two occur, as they do in *Castanea pumila* Miller.

Van Fleet, in one of the latest of his publications, referring to this chestnut, said:

Recently there has been brought to light in the interior of China a chestnut species that may restore our timber production of this most desirable wood, if it should prove immune to disease. Unlike other Old World chestnuts, which form relatively small trees, this species, *Castanea vilmoriniana* (now known as *Castanea henryi*), grows 80 to 100 feet high with a straight, symmetrical trunk well adapted for all timber purposes. The nuts, according to the scant herbarium material that has reached this country, are of little consequence except for propagation, as they are only slightly larger than those of our wild chinquapins. This species is now established at the Arnold Arboretum near Boston, Mass., and scions worked on *C. mollissima* stocks are now vigorously growing at Bell Experiment Plot, making fine upright shoots.[4]

Meyer, in exploration work carried on just prior to his death, spent considerable time near Ichang in Hupeh Province. Among some of the last collections sent in by him were specimens of what may have been this chestnut. This material, however, failed to grow. Although Gravatt, of the Office of Forest Pathology, Bureau of Plant Industry, reports that he has infected this species with blight, from the fact that the disease has not been reported on the specimen at the Arnold Arboretum nor on the one at Bell, Md., it may, like our native chinquapin, be a resistant type. Such a fine

[3] Sargent, C. S. plantae wilsonianae. Vol. 3, p. 197. 1916.

[4] Van Fleet, W. chestnut work at bell experiment plot. North. Nut Growers' Assoc. Rpt. Proc. 11th Ann. Meet., pp. 16–21. 1920.

tree is well worthy of further study and introduction. It may prove very useful as a timber tree and possibly as a tannin-producing tree. These are matters, however, that must be determined by further experiment.

The use of *Castanea henryi* for breeding purposes is to be commended. Crosses with our native chestnut (*C. dentata*) may give size, resistance to blight, and nuts of good quality and large size, all characters much to be desired. Crosses of *C. henryi* and *C. mollissima* may also produce valuable results. The latter lacks qualities as a timber tree which might be provided by *C. henryi*. Both these forms being resistant to blight, they would be likely to make the resultant cross more valuable.

CHINESE DWARF CHINQUAPIN

(*Castanea seguinii* Dode)

While agricultural explorer of the United States Department of Agriculture, with headquarters at Ichang, Hupeh Province, China, Meyer collected this chestnut on November 16, 1917. The following is his original note sent with the seeds (S. P. I. No. 45949) on the date mentioned:

> (No. 2459a. Ichang, Hupeh, China. November 16, 1917.) A shrubby chinquapin occasionally growing into a tree 25 to 40 feet high, occurring on mountain slopes here and there in central China often in great quantities. Sprouts only 2 feet high often produce nuts. It appears to be totally resistant to the bark fungus (*Endothia parasitica*) and may be of considerable value in breeding experiments such as Dr. Walter Van Fleet has been conducting for several years. This species seems to be more moisture loving than *Castanea mollissima*, but it grows well on the most barren mountain slopes. Chinese name *Moh pan li*, meaning "hairy board oak."

A few seedlings were grown and distributed from this lot of seeds; but, unfortunately, all have been lost. Wilson, collecting for the Arnold Arboretum, reports finding this chestnut in several localities in China. He raised a number of seedlings, but they were all lost by fire.

Sargent reports that this chestnut is very abundant on the hills and mountain sides throughout the Yangtsze Valley, from the neighborhood of Ningpo on the east to eastern Szechwan on the west. "It also grows in the Provinces of Shensi and Kweichow, but Wilson does not remember meeting with it in western Szechwan. Usually it is a bush or a low bushy tree, but under favorable conditions it forms a shapely tree from 12 to 15 meters tall, with spreading branches and a trunk 1 to 1.5 meters in girth."[5]

Castanea seguinii, like the timber chinquapin of China, may prove useful for breeding work. Its ability to resist blight is an important feature, and it would seem well worthy of further introduction and trial as a means of increasing our list of resistant and valuable chestnuts.

JAPANESE CHESTNUT

(*Castanea crenata* Sieb. and Zucc.)

The Japanese chestnut has been grown in this country for a number of years, but not so long as the European species. It is extensively grown in Japan and is widely used in that country as food for

[5] SARGENT, C. S. PLANTAE WILSONIANAE. Vol. 3, p. 195. 1916.

man; also for swine. In the fall the raw and roasted nuts are found offered for sale throughout the rural districts of Japan. School children are especially fond of them, and it is not uncommon to see the venders of hot roasted chestnuts gathered about the schoolhouses and doing a lively business at the noon hour. The tree is a vigorous grower, is blight resistant, and is very productive. The nuts are of rather indifferent quality, not comparing in sweetness and tenderness with the Chinese hairy chestnut and our own native species. A good many varieties have been developed by breeding and selection. Van Fleet gave much time and attention to selection for blight resistance. The Office of Foreign Plant Introduction has introduced the Japanese chestnut under 12 different S. P. I. numbers, and specimens of the trees listed under these numbers have been established at various places in the United States. This chestnut would seem to be of particular value as a possible source of improveing our blight-resistant strains and procuring trees of vigor and considerable size that might be of value for forest planting. It may develop that crossing this strain with *Castanea mollissima* or with our native species will result in obtaining trees useful for tannin production as well as timber and nuts.

EVERGREEN CHINQUAPINS

(*Castanopsis* spp.)

The members of the genus Castanopsis are mostly subtropical, and it is doubtful whether they will play a very important part in the economics of nut and timber production throughout our present chestnut belt. Reference has already been made to the extensive collections made by Mr. Rock in the Province of Yunnan, China. Altogether 28 lots of seeds were received, which represent three or probably four species. Only one of these, *Castanopsis delavayi* Franchet, has been grown in sufficient quantity to warrant a general distribution. Several thousand plants of this species are being grown at the United States Plant Introduction Garden, near Savannah, Ga., where they are not subject to infection from the blight fungus, as the disease does not exist in that region. This will make possible a distribution outside of the present blight area, especially to the southward and on the Pacific coast, where it seems important to test this species.

Several additional species of Castanopsis were collected by Mr. Rock, and collections of these have been placed at a number of points in order to test their climatic range and to provide future sources of material for study, and especially for breeding work. The more important collections are located at the United States Plant Introduction Garden, Bellingham, Wash.; Forest Service Pacific Northwest Experiment Station, Stabler, Wash.; United States Plant Introduction Garden, Chico, Calif.; United States Plant Introduction Garden, Savannah, Ga.; and at Brooksville, Fla., and St. Leo, Fla.

The following brief descriptions of the Yunnan, China, forms are based largely on Mr. Rock's field notes.

CASTANOPSIS DELAVAYI

(*Castanopsis delavayi* Franchet)

A tree reaching 80 feet in height with trunk 2 to 3 feet in diameter. The bark is brown or gray. Even when young all parts of

the tree are glabrous except for the under side of the shining leathery leaf, which is covered with dense silvery scales, like the leaf of an Elaeagnus, and is further distinguishable by being serrated only beyond the middle. The fruits are borne in axillary spikes, with 10 to 20 in each spike, and the burs are covered with about three concentric rings of sharp spines about half an inch long. There is generally but one nut in each bur, about one-half to two-thirds of an inch long and one-third to half an inch broad, ovoid or conical, looking much like a small filbert. Each nut contains two seeds, which is unusual for Castanopsis.

According to Rock, this is one of the noblest timber trees of Yunnan. It is not stated for what the timber is used, but the straight, long, unbranched trunk should contain a great many good board feet. The nuts, though as small as those of a chinquapin, are sweet; it is not stated by anyone that they are sold in Chinese markets.

This species apparently is not found outside of Yunnan Province, and in places even within the Province it is sometimes absent. Franchet, who first discovered it, mentions but two situations—wooded hills, Piiouse, and mountains above Tapintze. But Rock says it is found on the summit ridge of the Shweli-Salwin Divide at 8,000 feet and on the summit of a limestone range north of Likiang at an altitude of 8,200 feet. It is also very common on the Yangtsze River north of Likiang at Tungshan, Shiku, and Hgaza.

As for the region or regions where it may be expected to grow in this country, it is difficult, in the absence of climatic data from the mountains of Yunnan, to predict. Rock calls it "one of the finest and hardiest timber trees in this region," but that merely means hardy in Yunnan. It probably can not be counted on to succeed outside the Gulf States and California and possibly the coast region of Oregon.

CASTANOPSIS HYSTRIX

(*Castanopsis hystrix* DC.)

This species has been introduced and inventoried as S. P. I. No. 56768. Rock collected it in southwestern Yunnan, China. It has been reported from northern India where, in the Khasi Hills, it is said to grow at elevations of 2,000 to 3,000 feet. Rock's description follows:

[S. P. I. No. 56768.] A lofty tree 80 to 100 feet tall, with trunks 3 feet in diameter, found in the pine forests of the Shweli Valley 40 li (about 12 miles) north of Lungling at an altitude of 6,000 feet. The smooth fawn-colored bark is flaky, and the straight ascending branches give the tree an oblong appearance. The burs are in [illegible] densely packed spikes, and the involucres are covered with long soft gr[illegible] spines. The small nuts are borne singly or in twos. This is one of the finest forest trees of the region. According to the natives the wood is very durable and never attacked by insects.

OTHER SPECIES OF CASTANOPSIS

Four other species of Castanopsis collected by Rock should be noted. These were all found in Yunnan Province, western China.

[S. P. I. No. 56296.] A tall tree 70 to 80 feet in height, found on the slopes of the Likiang Snow Range at an altitude of 10,000 feet. The thick leathery leaves are silvery beneath, and the small edible nuts are sweet.

[S. P. I. No. 56298.] A tree 50 to 80 feet high, with a trunk 4 feet in diameter, found on the Salwin Ridge at an altitude of 8,000 feet. The dark-

green elliptic leaves are brown beneath, and the small black nuts are edible and sweet.

[S. P. I. No. 56299.] A tree 40 to 50 feet high, with a trunk 1 to 2 feet in diameter, which grows in the mountains north of Tengyueh at altitudes of 7,000 to 8,000 feet. The broad oval leaves are pointed, with the upper half toothed, and the spines on the burs are arranged in concentric rings. The small nuts are edible and sweet.

[S. P. I. No. 56300.] A tree 60 to 80 feet high, with a trunk 2 to 3 feet in diameter, found in the mountains north of Tengyueh at altitudes of 7,000 to 8,000 feet. The small elliptical dark-green leaves are thick and leathery, and the burs, an inch in diameter, are covered with branched spines. Each bur contains two or three brown, pubescent, sweet edible nuts.

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